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COMPLETE SPECIFICATION

Composition and process for improving the Colour of Meat and Meat Products

We, WILLIAM LEWIS BROWN, 206 Filmore, Ottumwa, Iowa, United States of America, and MORTON LEE SCHMUCKER, 151 West Alta Vista, Ottumwa, Iowa, United States of America, both citizens of the United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to the curing of meat, and in particular to a composition and method for accelerating color development and improving the retention of color during the curing and subsequent storage and display of cured meat.

Numerous studies have been conducted on the chemical reactions occurring during the curing of meats and more specifically, the color changes and development in the meat caused by the pigments present, which undergo various chemical reactions during and after curing. Changes in the meat pigments evidenced by color variations of the meat during and following the curing process are taken by consumers to be a direct indication of the quality of the cured meat. A bright pink to red cured meat color in bacon, ham and most types of prepared meat products, is virtually a "must" today for consumer acceptability.

The use of nitrates are well known in meat curing processes. The broad statement that the nitrite reacts with the meat pigment to produce the so-called cured meat color covers many individual chemical and physical reactions and changes, but is commonly accepted by the industry. The color development reactions in meat occur during the "cure," the "holding period" and in the subsequent processing, i.e., cooking or smoking. When a long cure is utilized, the pH, enzyme activity, and the fundamental properties of meat combine to produce conditions favorable to the color developing reactions. When the curing is accelerated, as is most often the case in the industry today, the favorable natural conditions are materially decreased. Accordingly, various reagents and compositions have been used or proposed for use to aid in developing the desired color of the slower cured meats.

Studies have indicated that myoglobin is the principal naturally occurring pigment in red meats and that during curing this pigment is ultimately converted to nitric oxide myoglobin, commonly called nitrosomyoglobin, which pigment provides the desired reddish pink color of cured meat.

Myoglobin consists of two distinct parts, globin and heme. One atom of iron is bound in the center of the heme molecule. The iron atom is the principal factor in the chemical reactivity of the myoglobin, which reactivity accounts for the numerous and varied colors in meat. The globin is a protein molecule to which the heme molecule is bound by one bond from the iron atom and several others from the rest of the heme molecule. In the myoglobin molecule one bond of the iron is, so to speak, free. It is this "free bond" which provides the function for reacting with other atoms and molecules. For example, in myoglobin a molecule of water is bound to the iron and the pigment is a purplish-red color; in oxymyoglobin, which is reddish pink, a molecule of nitric oxide is bound to the iron. The nitric oxide containing pigment, that is, nitrosomyglobin, may exist in two forms, "native" and "denatured." Since the native form is soluble in water, the nitroso pigment as it occurs in cured meat appears to be in the denatured form for the reason that the color of cured meats is not extractable with water.

While the exact physical configuration of the cured meat pigment nitrosomyoglobin is not known, it is apparent that the final pigment is a result of two reactions, namely, formation of nitric oxide from nitrite with subsequent combination of the heme and nit-

ric oxide, and the physical or chemical denaturation of the globin or protein portion of the molecule. The first process is chemical and consists of reducing nitrite to nitric oxide with simultaneous reduction of the iron in the pigment from the ferric state to the ferrous state, the second is a physical change involving the denaturation of the protein as mentioned previously. It now may well be appreciated that the broad statement to the effect that nitrite reacts with the meat pigment to produce the so-called cured meat color covers many individual reactions and changes. The reactions occurring may be summarized as follows:

1. NO_3- [H] → NO_2- [H] → NO
   (nitrate) (nitrite) (nitric oxide)
2. NO + Myoglobin → Nitrosomyoglobin
3. Nitrosomyoglobin —heat, chemicals or other denatured proteins→ Denaturated Globin

While myoglobin is perhaps the predominant pigment in meat, meat contains other oxygen bearing pigments, for example hemoglobin and cytochrome. These oxygen bearing pigments also vary greatly in color according to their state of oxidation, for example, purplish red, bright red, pink, greyish brown.

It is a common experience to note variations in color of meats, meat products and fresh meat particularly from the exterior to the interior. These color variations are explainable inasmuch as when the surface of the meat is initially contacted with atmospheric oxygen, the oxygen reacts with the myoglobin present at or near the meat surface to form oxymyoglobin, a bright red. At the same time, the myoglobin in the interior of the meat body is a purplish-red color due to its reduced state. Simultaneously, the hemoglobin pigment present upon exposure to atmospheric oxygen also undergoes various color changes from the purplish-red of the hemoglobin to the greyish-brown color of the oxidized pigment. It may well be appreciated that the net result is unattractive and unappetizing, indicative of incomplete color development in the curing process. In the case of "fresh" meats, particularly ground varieties, this does not evoke a sense of freshness to the purchasing public. The problems entailed in proper color development of meats are probably most acute in the manufacture of cooked, cured and comminuted meat products such as weiners or frankfurters, bologna, sausage, corned beef and the like which require more handling and present more surface area, hence greater exposure to the deleterious effects of light and oxygen than in the case of other meats.

As mentioned hereinbefore, to prevent these undesirable variations in the oxidation state of the pigments, various reducing agents, in particular ascorbic acid and its derivatives, have come into wide usage. These antioxidants are commonly utilized in the holding and processing steps of curing and in the cooking, curing and comminution of prepared meat products. The role of ascorbate in color reaction is described in U.S. Patent Number 2,541,572 and U.S. Patent Number 2,739,899.

Throughout this application, the term "ascorbate" will be used as a general term to cover ascorbic acid and related compounds, for example sodium ascorbate, erythorbic acid (sometimes known as isoascorbic acid), sodium erythorbate and the like.

In addition to better color development during nitrite cures, it is recognized that use of ascorbate accelerates color development thus permitting shorter curing or holding times. These factors permit faster turnover, higher production and better product condition with no sacrifice in color or color uniformity.

While the use of reducing agents or antioxidants has greatly improved development of bright, uniform colors throughout the meat and has enabled accelerated processing time, the use of these agents per se does not overcome the problem of discoloration or pigment reactivity upon prolonged exposure to light and oxygen in storage as in meat market show cases.

The desired bright reddish-pink color of cured meat is not stable upon prolonged exposure to light and air, that is, the meat becomes multicolored, discolored or fades upon such exposure. These color changes are again attributable to the chemical and physical reactivity of the pigments present. Many attempts have been made to overcome this problem, for example, by vacuum packaging of meat after processing, by the use of oxygen impervious wrappers or package films, and by means of various surface contact materials. One of the major problems incurred in color development is based on the many varieties of meats per se, for example, pork, beef, lamb, the various cuts thereof, the ques-

tion of whether the meat is cooked, comminuted or ground, the quantity and molecular configuration of the fat and lean present, and the variations from cut to cut. Heretofore there has been no known single composition which could be utilized in the curing, processing and storing of this wide variety of meats, cuts and products to achieve uniformity in color development and stability of the color in the finished product.

This invention provides a composition and method which may be advantageously utilized in the treatment of all meat and meat products and in particular in all nitrite meat cures, offering the advantages of faster and more uniform color development enabling shorter curing or holding times with no sacrifice in color uniformity.

It is a major advantage that the composition and method of this invention provide more stable color development to the end that in the case of meat or meat products in which the composition of this invention has been used, a more stable color is maintained during storage or exposure ot air and light.

It is an advantage of the present invention that the composition and method may be used in all nitrite curing processes.

Another advantage provided by the composition of this invention is complete reduction of the nitrite to nitric oxide during the cure and conversion of metmyoglobin to myoglobin for reaction with nitric oxide. The composition and method of this invention in addition eliminate incomplete and slow reactions between myoglobin and nitric oxide and result in faster and more efficient cures. Thereby the curing and holding are substantially reduced in time to the end that shrinkage is reduced and increased yields are provided.

Not the least of important advantages realized by use of the composition of this invention is the provision of stable color development and stability of the color of the finished product which composition is provided in standardized units to the end that curing, processing and treating of the numerous varieties of meats, cuts, and products, do not have to be individualized.

In accordance with this invention, a composition is provided for the treatment of fresh meat and meat products during cure comprising the combination of a citrate with a reducing agent. While a wide variety of approved reducing agents have been found suitable for use in the compositions of this invention, such as ascorbic acid; sodium ascorbate; erythorbic acid; sodium erythorbate; butylated hydroxyanisole; butylated hydroxytoluene; nordihydroguaiaretic acid; propyl gallate and ascorbyl palmitate; in the preferred embodiment sodium erythorbate (hereinafter sometimes referred to as erythorbate) is used as the reducing agent. Citric acid and its water-soluble salts are the citrates contemplated for use in the composition.

The following examples will illustrate the composition prepared in accordance with the present invention and the method of utilization, the scope of the invention not, however, being limited to the specific details of these examples.

Example 1

Tablets were prepared as follows: A tablet base was prepared comprising erythorbic acid, citric acid, sodium bicarbonate and excipients. The mixture was tableted so that each tablet contained 6.25 g. erythorbic acid, 6.25 g. citric acid, 6.0 g. sodium bicarbonate, and 1.5 g. excipients. One tablet contains 6.25 g. or about 7/32 ounce each of erythorbic and citric acids, which is equivalent to about 1/4 ounce each of sodium erythorbate and sodium citrate. The number of tablets used in the treatment of any particular meat is dependent upon the type and form of the meat being treated.

Prior to treatment the tablets are dissolved in water in the proportion of approximately 2 tablets to 8 ounces of water. While not essential to the most effective use of the composition, it is desirable that the tablet not be dissolved in water until just prior to use.

CURING OF MEAT

Sausage Products

Two tablets containing 7/8 ounce of a mixture of erythorbic acid and citric acid per 100 pounds of meat are used. The tablets are dissolved in 8 ounces water per tablet and added to the meat 2 or 3 minutes before the end of comminution. After the tablet solution has been added, smoking is carried out as follows: (Initial smoke-house temperatures should not exceed 140° F.).

Frankfurters: After the outside color develops (about 45 minutes at 140° F.) the temperature is raised rapidly to 160° to 170° F. and held until an internal temperature of 146° F. is reached. Live steam is then used until an internal temperature of 152° F. is reached.

Bologna (and large sausage): The temperature is raised slowly to prevent bursting, hardening of casings and rendering, but enough time is allowed to have the internal temperature of the product reach 152° F.

It is essential, when utilizing the compositions of this invention in the preparation of prepared meat products, that care be exercised to completely heat treat the product inasmuch as color development is obtained prior to complete internal pasteurization.

Example 2

Ham, Corned Beef, and Bacon

An aqueous solution of the composition of this invention is introduced into the meat by conventional stitch or arterial pumping

methods.

A. Pickling solution: Two tablets containing the equivalent of 1/2 ounce sodium erythorbate and 1/2 ounce sodium citrate are dissolved in a cup of lukewarm water and added per 1 gallon of pickle.

B. Dry and Semi-Dry Cures: Two tablets per 100 pounds of meat are crushed and added to the curing salts with thorough mixing and the mixture used in the usual way.

The ham and bacon were cured for 0-5 days at 40° F. and smoked in the conventional manner in the smoke-house.

The corned beef was cured and put into heat shrinkable plastic bags and vacuum closed.

The following examples will illustrate the advantages obtained by utilizing compositions of this invention in the preparation of comminuted meat and meat products, for example, weiners, bologna, sausage and chopped canned meats. A comparison is made in these examples between meat prepared utilizing the compositions of this invention with meat prepared using an antioxidant alone.

EXAMPLE 3

An emulsion having the following formulation was prepared:

Boneless Beef	450 lb.
Pork Regular Trimmings	550 lb.
Corn Syrup	30 lb.
Water and Ice	320 lb.
Salt, Cure, Spices	48 lb.

The emulsion was divided into 2 equal portions. To 1 portion was added a composition comprising 2 ounces of erythorbate and 2 ounces of citric acid, to the other portion 4 ounces of erythorbate was added. The mixture was chopped for 1 to 2 minutes. The regular trimmings were then added and the mixture chopped at 45°F. The emulsion was then separated into 2 portions and the amounts indicated above of antioxidant and the inventive composition added to the respective emulsions. The chop was then continued for 1/2 minute. The emulsions were then put through a mixing machine, stuffed, linked and processed in a smoke-house as follows:

45 minutes at 140° F., 60 minutes at 160° F., then 170° F. to an internal temperature of 146° F. The emulsions were then put through a 160° F. water spray to an internal temperature of 152° F. and then subjected to a cold water shower for 10 minutes followed by a blast chilling.

Samples of each emulsion were checked repeatedly during processing for color development, the colors being rated on and defined by means of a Munsell Color Disk. Nickerson, D., "Color Measurement and Its Application to the Grading of Agricultural Products," U.S. Department of Agriculture, 1946. The results are summarized in Table 1.

TABLE 1

4 oz. Erythorbate per 500 lb. Batch		Munsell Color Ratings		Munsell Color Ratings		2 oz. Erythorbate + 2 oz. Citric Acid per 500 lb. batch	
Time	Internal Temp.	Red	White	Red	White	Time	Internal Temp.
75	118° F.	55	18	55	18	60	115° F.
90	122° F.	57	16	57	15	75	118° F.
130	147° F.	60	14	59	14	90	122° F.
133	154° F.	61	13	61	12	105	130° F.

From these figures it can be seen that the mixture of ascorbate and citric acid produces a color comparable to ascorbate alone in a shorter period of time and at a lower internal temperature.

EXAMPLE 4

An emulsion having the following formulation was prepared:

Boneless Beef	350 lb.
Beef Navel Ends	650 lb.
Corn Syrup	30 lb.
Water and Ice	320 lb.
Salt, Cure, and Spices	50 lb.

The emulsion was divided into 2 equal parts. To 1 part was added 4 ounces of a composition comprising erythorbate and citric acid and to the other portion was added 4 ounces of erythorbate.

All ingredients were chopped until the emulsion temperature reached 45° F. The erythorbate-citric acid composition and the erythorbate alone were added to the respective emulsions 1/2 minute before the end

of chop. The mixture was then put through a mixing machine, stuffed, linked and processed in a smoke-house as follows. 1 and 1/2 hours at 120° F.; 1/2 hour at 140° F.; 1/2 hour at 160° F.; then 170° F. to an internal temperature of 146° F. followed by 165° F. water spray to an internal temperature of 152° F. and subsequently passed into a cold water shower for 10 minutes, followed by blast chilling.

The Munsell color readings of the finished frankfurters are shown in Table 2.

TABLE 2

	Red	Yellow	Black	White
Franks with Erythorbate	63	12	9	16
Franks with Erythorbate + Citric Acid	69	10	9	12

It is readily observable that the franks containing the mixture of this invention were in fact a better color than identical franks containing erythorbate alone. The improvement in red color was evident by Munsell color disk and visually by a trained panel.

EXAMPLE 5

Emulsions having the following formulation were prepared:

Boneless Beef	80 lb.	80 lb.
Beef Navel Ends	100 lb.	100 lb.
Beef Cheek Meat	100 lb.	100 lb.
Pork Jowl	150 lb.	150 lb.
Pork Head Skin Trimmings	70 lb.	70 lb.
Corn Syrup	15 lb.	15 lb.
Water and Ice	150 lb.	150 lb.
Salt, Cure and Spices	24 lb.	24 lb.
Erythorbate	4 oz.	2 oz.
Citric Acid	none	2 oz.

The boneless cow, beef cheeks, syrup, water, salt and spices were chopped for 1 to 2 minutes. The rest of the meats were then added and chopped to an emulsion temperature of 45° F. Erythorbate (A) or erythorbate plus citric acid (B) was added 1/2 minute before the end of the chop. After chopping and mixing, it was stuffed, linked and processed in a smoke-house as follows: 1 hour at 120° F.; 1/2 hour at 140° F.; 1/2 hour at 160° F.; then 165° F. to an internal temperature of 146° F.; a 165° F. water spray to an internal temperature of 152° F. followed by a cold water spray for 10 minutes, then to blast chill.

Munsell color readings on the finished franks are set out in Table 3.

TABLE 3

	Red	Yellow	Black	White
Franks with Erythorbate	59	13	9	19
Franks with Erythorbate + Citric Acid	63	12	12	13

Again we obtained a more desirable, redder color with the invention mixture than by using the antioxidant alone. The marked improvement is shown to occur with various formulas and various ingredients.

EXAMPLE 6

An emulsion having the following formulation was prepared:

Boneless Beef	225 lb.	225 lb.
Pork Regular Trimmings	275 lb.	275 lb.
Corn Syrup	15 lb.	15 lb.
Water and Ice	150 lb.	150 lb.
Salt, Cure and Spices	24 lb.	24 lb.
Erythorbate	4 oz.	2 oz.
Citric Acid	none	2 oz.

The meat emulsions were processed as in Example 1. Munsell color readings on the finished franks are summarized in Table 4.

TABLE 4

	Red	Yellow	Black	White
Franks with Erythorbate	59	8	7	26
Franks with Erythorbate + Citric Acid	62	9	7	22

EXAMPLE 7

For the reason that bologna is processed in a considerably larger diameter casing than franks, and since the time/temperature relationships during processing are therefore considerably different, the effects of the composition of the invention are less pronounced but still definitely measurable.

Boneless Beef	250 lb.	250 lb.
Pork Head Meat	125 lb.	125 lb.
Pork Jowl	125 lb.	125 lb.
Corn Syrup Solids	12 lb.	12 lb.
Water and Ice	110 lb.	110 lb.
Salt, Cure and Spices	22 lb.	22 lb.
Erythorbate	none	2 oz.
Citric Acid	none	2 oz.

The boneless cow, corn syrup solids, water, salt, cure and spices were chopped for 3 minutes, then the pork head meat added and chopped for 3 minutes, then jowl added and chopped for 3 minutes. Where erythorbate plus citric acid was used, it was added 1/2 minute before end of chop. Out chop to stuffing, then processed in a smoke-house as follows: 1 hour at 130°F.; 1 hour at 150° F.; then hold 180° F. to an internal temperature of 152° F.; then cold water spray for 3/4 hour, then to blast chill. Munsell color readings on the finished bologna are set out in Table 5.

TABLE 5

	Red	Yellow	Black	White
Plain Bologna	51	9	6	34
Bologna + Erythorbate + Citric Acid	54	9	6	31

EXAMPLE 8

This example illustrates the advantages of the use of the compositions of this invention upon meats in storage. The meat product was prepared and processed as in the preceding examples.

Boneless Beef	225 lb.	225 lb.
Pork Regular Trimmings	275 lb.	275 lb.
Corn Syrup	15 lb.	15 lb.
Water and Ice	150 lb.	150 lb.
Salt, Cure, Spices	24 lb.	24 lb.
Erythorbate	4 oz.	2 oz.
Citric Acid	none	2 oz.

Internal colors were checked at various storage ages (storage at 45° to 50° F.) which are shown in Table 6. In 4 out of 5 storage periods (0 to 12 days) the erythorbate plus citric acid treated frankfurters were scored higher than the control by the Munsell color disk method of evaluation.

TABLE 6

Frankfurters

	Ascorbate		Ascorbate + Citirc Acid	
Storage Age	Munsell Color Red	White	Munsell Color Red	White
0 days (fresh)	53	25	55	25
1	58	20	57	22
4	57	21	58	21
8	56	22	58	20
12	55	23	57	22

It will be appreciated that a great variety of meats are commonly used in weiners or frankfurters, for example boneless cow, beef navel, beef cheek, pork regular trimmings, pork jowl, pork head, skin trims, veal, mutton and others and in various proportions with each other. The same holds true for bologna. Standard formulation procedures may include grinding, chopping, roto-cutting, mixing, and/or combinations of these. Processing temperatures can cover any temperatures from 100° F. to 200° F. and may consist of a single temperature or any combination of times and temperatures to give the desired internal temperature of the product. The product may move continuously through pro-

cessing or be held between various steps of formulation, stuffing or processing. Such holding times can vary from minutes to a day or more and holding temperatures may vary from 30° F. to 100° F.; however, it is to be understood that the compositions of this invention achieve the heretofore set out advantages regardless of these variables in the preparation of the meat products.

EXAMPLE 9

To demonstrate the effects of various known antioxidants, synergists, chelating agents, on the color reaction during cure as compared with the compositions of this invention the following test was made.

A fast 1 hour cure and a fast processing (15 minutes, 140° F.) were used so as to observe the maximum effects of the reactant. Each reagent composition or reagent was intimately mixed into a sample of ground, fresh meat (pork) and another sample of the reagent stitch-pumped via a curing solution into a chunk of identical meat (pork). A thin layer of the ground meat and a thin slice of the cured meat each were sealed in plastic bags for processing. To prevent uncontrolled variations due to a variable exposure to air, all operations were conducted in a carbon dioxide atmosphere. The plastic bags were vacuum closed (28 inch vacuum). Finished colors were rated visually and by Munsell Color Disks. The results are shown in Table 7.

TABLE 7

CURE	Visual Determination	Munsell Color Rating			
		Red	Yellow	Black	White
1. Salt[a] + Nitrite[b] (in air)	Poor	60	7	9	24
2. Salt[a] + Nitrite[b] (in bag)	Fair	71	2	9	18
All of the following cures comprised Salt and Nitrite, plus:					
3. Ascorbic Acid[c]	Good	70	3	9	18
4. Sodium Erythorbate[d]	Good	70	2	9	19
5. Sodium Erythorbate[e] + Citric Acid[e]	Excellent	72	1	9	18
6. Sodium Erythorbate[e] + Sodium Citrate[e]	Excellent	72	2	8	18
7. Propylene Glycol[f]	Worst	55	13	13	19
8. Tenox (R.T.M.) R[g]	Poor	69	2	10	19
9. Tenox (R.T.M.) II[h]	Very Poor	61	2	11	26

(a) 50 base brine or 3% in the meat
(b) 20 oz./100 gal. or 100 ppm in the meat
(c) 70 oz./100 gal. or 0.047% in the meat
(d) 85 oz./100 gal. or 0.055% in the meat
(e) 42 oz./100 gal. or 0.024% in the meat
(f) 268 oz./100 gal. or 0.15% in the meat
(g) 420 oz./100 gal. or 0.24% in the meat (0.045% BHA, 0.15% propylene glycol)
(h) 420 oz./100 gal. or 0.24% in the meat (0.045% BHA, 0.014% propyl gallate, 0.17% propylene glycol)

EXAMPLE 10

To demonstrate the improvement in speeding the color reaction, thin slices of bacon were fast cured and processed in pickles containing the customary curing ingredients, that is salt, sugar, sodium nitrite, and sodium nitrate. One half of the slices were cured utilizing with nitrite cure an addition compri-

sing erythorbate and sodium citrate. The salt was adjusted to give 1.5% salt in the finished product; sugar 1%, and nitrite, 60 parts per million in the finished product. The erythorbate-sodium citrate composition was used in an amount of 2 tablets or 1/2 oz. erythorbate plus 1/2 oz. sodium citrate per gallon of curing pickle. The bacon slices were simultaneously cured and processed by immersion in the curing pickles. The time of developing and the color description are set out in Table 8.

TABLE 8

Temp. (°F.)	Time, (Min.)	Color Description Plain Cure	Color Description When Cured With Erythorbate + Sodium Citrate
125	30	Internal lean — developing pink; surface lean — much less pink.	Definitely better red than control but color not fully developed.
125	60	Internal lean — much like 30 min.; surface lean — still very dull.	Color closer to developed than 30 min. much better than 60 min. with no erythorbate and citrate.
140	10	Internal lean — developing pink; surface lean — much less pink.	Internal lean — good pink color; surface lean — red/pink.
140	20	Internal lean — pink not complete; surface lean — pinker, not yet good.	Good color, both internal and surface.
140	30	Pinker but still not good color.	Good, uniform color.

The effect of the composition comprising erythorbate plus citrate in fostering and speeding the color development reaction is clearly demonstrated in the above Table 8. As previously discussed, these effects are maximum with a fast cure and processing, decreasing progressively with longer curing and processing time.

EXAMPLE 11

A similar study was conducted on ham color development. Thin slices of ham were used as samples and the method utilized as described above for the bacon samples, except that the curing-processing temperature was maintained at 140° F. The same speeding of color development was observed:

TABLE 9

Time (Min.)	Control	Erythorbate (1 oz. per gal.)	Erythorbate + Sodium Citrate (1/2 oz. each per gallon)
10	Good pink color	Better pink — equal to control at 20 min.	Best, brightest pink — better than 10 min. erythorbate.
20	Better pink color	Best, brightest pink	Like erythorbate + citrate at at 10 min.
30	Equal to control at 20 min.	Not quite as good as 20 min. erythorbate.	Like erythorbate + citrate at 10 min.

In summary there is provided by this invention a composition useful during meat curing which comprises the combination of a citrate and a reducing agent such as an ascorbate or erythorbate. The use of this composition results in the production and maintenance of a more desirable and more stable color of the cured meat.

WHAT WE CLAIM IS:

1. A method of improving the color of meat which comprises contacting the meat during curing with a composition comprising citric acid or a citrate and reducing agent.

2. A method as claimed in claim 1 wherein the reducing agent is ascorbic acid, sodium ascorbate, erythorbic acid, sodium erythor-

bate, butylated hydroxyanisole, butylated hydroxytoluene, nordihydroguaiaretic acid, propyl gallate or ascorbyl palmitate.

3. A method as claimed in claim 1 or 2 wherein the citrate is a water-soluble salt of citric acid.

4. A method as claimed in any of claims 1 to 3 wherein the reducing agent is erythorbate.

5. A method as claimed in claim 3 wherein the citrate is sodium citrate.

6. A method of improving the color of meat substantially as described with reference to the examples.

7. Meat treated by the process claimed in any of the preceding claims.

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